EDEXCEL FOUNDATION

Stewart House 32 Russell Square London WC1B 5DN

June 2002

Advanced Subsidiary /Advanced Level

General Certificate of Education

Subject STATISTICS 6687 Paper No. S5

Question number	Scheme	Marks
1.	(a) $M_X(t) = \int_0^2 0.5\, e^{tx}\, dx$ Use of $M_X(t)$	M1 A1
	$= \left[\frac{0.5 e^{tx}}{t}\right]_0^2$	A1
	$= \left[\frac{0.5e^{2t}}{t}\right] - \left[\frac{0.5}{t}\right]$	
	$= \frac{1}{2t}\left(e^{2t}-1\right)$ * A.G. c.w.o	A1 (4)
	(b) $M_X(t) = \dfrac{2t + \frac{(2t)^2}{2!} + \frac{(2t)^3}{3!} + \ldots}{2t}$	M1
		A1
	$= 1 + t + \frac{2}{3}t^2 + \ldots$	
	$\mu = M'(0) = 1$; $\sigma^2 = M''(0) - \{M'(0)\}^2 = \frac{1}{3}$	A1; A1 (4)
2.	(a) $X \sim Geo(0.4)$	B1
	$E(X) = \frac{1}{p} = \frac{1}{0.4} = 2.5$	B1 (2)
	(b) $W \sim$ Neg. Bin ($r = 2$ etc)	
	$E(W) = \frac{r}{p} = \frac{2}{0.4} = 5$	M1 A1
	$Var(W) = \frac{r(1-p)}{p^2} = \frac{2 \times 0.6}{0.4^2} = 7.5$	M1 A1 (4)
	(c) $P(W = 5) = \binom{5-1}{2-1} 0.4^2 \times 0.6^3 = 0.13824$ 0.138	M1 A1 (2)

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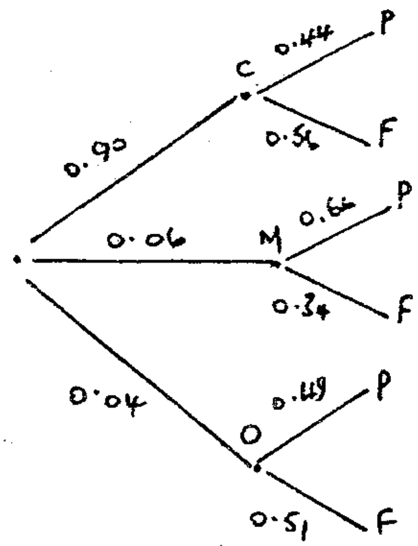
3.	(a) 		
	$P(\text{Passes on } 1^{st} \text{ attempt}) = (0.90 \times 0.44) + (0.06 \times 0.66) + (0.04 \times 0.49)$		M1
	$= \underline{0.4552}$	0.455	A1 (2)
	(b) $P(\text{Car} \mid \text{pass } 1^{st} \text{ time}) = \dfrac{0.90 \times 0.44}{0.4552}$		M1
	$= \underline{0.8699\ldots}$	0.870	A1 (2)
	(c) $P(C \& M) = 0.9 \times 0.44 \times 0.06 \times 0.66 \times 2$		M1
	$= \underline{0.0313632}$		A1
	$P(C \& O) = 0.0155232$; $P(M \& O) = 0.00155232$	both	A1
	$\therefore P(C \& M \mid \text{Diff category}) = \dfrac{0.0313632}{0.0313632 + 0.0155232 + 0.00155232} = \dfrac{0.0313632}{0.04844352}$		M1 A1
	$= \underline{0.6474\ldots}$	0.647	A1 (6)

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Question number	Scheme		Marks
4.	(a) Let X represent number of power cuts/month $\therefore X \sim Po(0.5)$		M1
	$\therefore P(X=1) = 0.9098 - 0.6065$ or $0.5e^{-0.5} = \underline{0.3033}$		A1 (2)
	(b) $P(0 \le T \le t) = \int_0^t 0.5e^{-0.5x}\,dx = \left[-e^{-0.5x}\right]_0^t$	$\int_0^t f(x)dx$	M1
		$-e^{-0.5x}$	A1
	$= \underline{1-e^{-t/2}}$	c.w.o.	A1 (3)
	(c) (i) $P(2 \text{ months or less}) = 1-e^{-2/2} = \underline{0.63212...}$	0.632	M1 A1
	(ii) $P(\text{between } 2 \,\&\, 3 \text{ months}) = (1-e^{-3/2}) - 0.63212...$		M1
	$= \underline{0.14474....}$	0.145	A1 (4)
	(d) $P(\text{No cuts in } m \text{ months}) = 0.8$		M1
	$\therefore e^{-t/2} = 0.8$		M1
	$\therefore \underline{t = 0.44628....}$	0.446	A1 (3)
5.	(a) $P(\text{accepted after } 1^{st} \text{ sample}) = (1-0.04)^{10} = \underline{0.6648...}$	0.665	B1 (1)
	(b) $P(9 \text{ pass}) + P(8 \text{ pass}) = 10(.96)^9(.04) + 45(.96)^8(.04)^2$		M1 A1 A1
	$= \underline{0.32895....}$	0.329	A1 (4)
	(c) $P(\text{accepted after } 2^{nd} \text{ sample}) = P(9\ 1^{st} \,\&\, 10\ 2^{nd}) + P(9\ 1^{st} \,\&\, 9\ 2^{nd})$ $+ P(8\ 1^{st} \,\&\, 10\ 2^{nd})$		M1 A1
	$= 10(.96)^9(.04)\times(.96)^{10} + \{10(.96)^9(.04)\}^2$		A1
	$+ 45(.96)^8(.04)^2\times(.96)^{10}$		
	$= 0.184167... + 0.076736... + 0.034531...$		A1
	$= \underline{0.295434.....}$		A1
	$\therefore P(\text{acceptance}) = P(\text{accepted after } 1^{st} \text{ sample}) + P(\text{after } 2^{nd} \text{ sample})$		M1
	$= 0.6648... + 0.2954... = \underline{0.9602..}$	0.960	A1 (7)

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6.	(a) P(Joan succeeds on 6^{th} throw) = $(0.6)^5(0.4)$		M1
	$= 0.031104$	0.0311	A1 (2)
	(b) P(At least 3 failures) = 1 − P(≤ 2 failures)		
	$= 1 - P(0) - P(1) - P(2)$		M1
	$= 1 - (0.4) - (0.6)(0.4) - (0.6)^2(0.4)$		
	$= 0.216 = \frac{27}{125}$		A1 (2)
	(c)(i) P(Harry wins on his 3^{rd} throw) = $(0.6)^3 \times (0.7)^2(0.3)$		M1
	$= 0.031752$	0.0318	A1
	(ii) P(Joan wins) = $0.4 + 0.6 \times 0.7 \times 0.4 + (0.6 \times 0.7)^2 \times 0.4$		M1
	$= \dfrac{0.4}{1 - (0.6 \times 0.7)}$		M1
	$= 0.68965....$	0.690	A1 (5)
	(d) P(Joan win) = $(0.5 \times 0.6^2 \times 0.7^2 \times 0.4) + (0.5 \times 0.7^3 \times 0.6^2 \times 0.4)$		M1A1
	$= 0.03528 + 0.024696$		
	$= 0.059976$	0.0600	A1 (3)

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7.	(a) $G_X(1) = 1$	M1
	$k(2+1)^4 = 1$	M1
	$\therefore k = \frac{1}{81}$ ¥ A.G	A1 (3)
	(b) $E(X) = 4/3$; $Var(X) = 8/9$	B1; B1 (2)
	(c) $G_Z(t) = G_X(t) \times G_Y(t)$	
	$= \frac{1}{81}(2+t)^4 \times \frac{1}{243}(2+t)^5$	M1
	$= \frac{1}{19683}(2+t)^9$	A1 (2)
	(d) $G_Z'(t) = \frac{9}{19683}(2+t)^8 \Rightarrow E(Z) = G_Z'(1) = \frac{9 \times 3^8}{19683} = 3$	M1 A1
	$G_Z''(t) = \frac{72(2+t)^7}{19683} \Rightarrow G_Z''(1) = \frac{72 \times 3^7}{19683} = 8$	M1 A1
	$\therefore Var(Z) = G_Z''(1) + G_Z'(1) - \{G_Z'(1)\}^2$	
	$= 8 + 3 - 9$	M1
	$= 2$	A1 (6)